

Hormonal Communication

1. Which of the following is / are interventions in the control of blood glucose concentration?

Statement 1: Insulin injection.

Statement 2: Regular cardiovascular exercise.

Statement 3: Glucagon injection.

- A** 1, 2 and 3
- B** Only 1 and 2
- C** Only 2 and 3
- D** Only 1

Your answer

[1]

2. The following are statements about the liver:

- 1** stores bile in the gall bladder
- 2** contains sinusoids
- 3** receives blood from the gut and heart

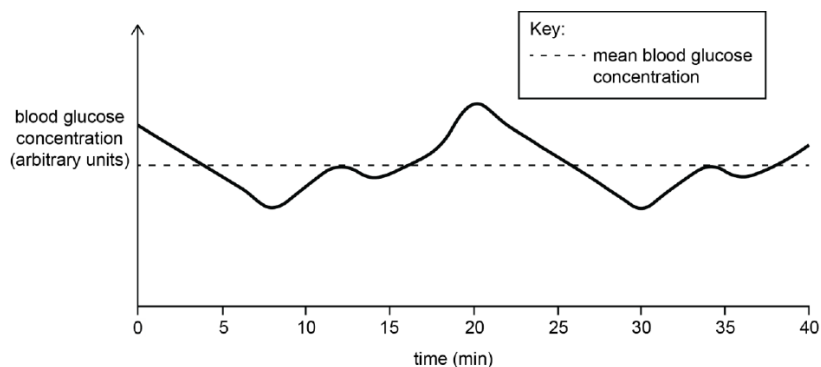
Which of these statements relate to the exocrine function of the liver?

- A** 1, 2 and 3
- B** Only 1 and 2
- C** Only 2 and 3
- D** Only 1

Your answer

[1]

3. The graph below shows the change in glucose concentration in a rat's bloodstream over a short period of time.



Which of the statements, **A** to **D**, is correct?

- A** blood glucose concentration at 15 min > blood glucose concentration at 20 min
- B** blood glucose concentration at 9 min << blood glucose concentration at 20 min
- C** blood glucose concentration at 0 min < blood glucose concentration at 40 min
- D** blood glucose concentration at 5 min >> blood glucose concentration at 28 min

Your answer

[1]

4. The following terms relate to the metabolism of carbohydrates in the human body:

- 1 gluconeogenesis
- 2 glycogenesis
- 3 glycolysis

Which of these processes will be stimulated when glucagon is released into the bloodstream?

- A** 1, 2 and 3
- B** Only 1 and 2
- C** Only 2 and 3
- D** Only 1

Your answer

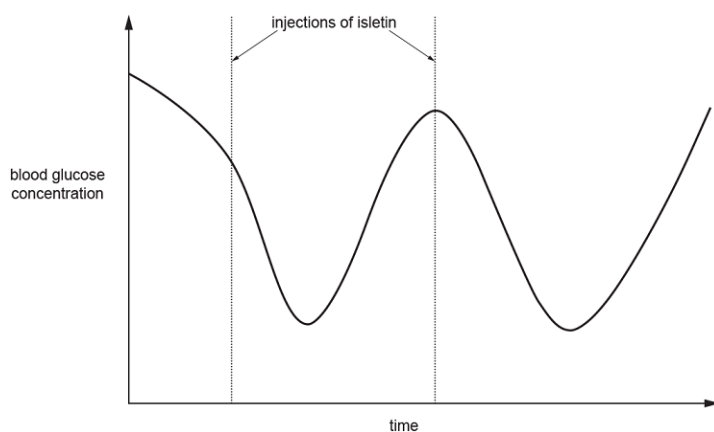
[1]

5. Banting and Best pioneered experiments into the functions of the pancreas.

In one experiment, they removed the pancreas of dogs. Shortly afterwards, the dogs developed the symptoms of diabetes.

- Banting ground up the removed pancreas to produce an extract.
- He called the extract "isletin".
- The isletin was then injected into dogs that had had their pancreas removed.
- He then tested the blood glucose concentration.

The graph below is a summary of the results.



Which of the following statements correctly explains these results?

- 1 Isletin is made in the α cells in the islets of Langerhans.
- 2 Isletin reduces blood glucose concentration.
- 3 The effects of isletin are short-lived.

- A** 1, 2 and 3
B Only 1 and 2
C Only 2 and 3
D Only 1

Your answer

[1]

6. The hormone aldosterone is produced by the adrenal cortex. Excess production of aldosterone can result in high blood pressure.

The following statements describe processes that occur as a result of aldosterone secretion:

- 1 Na^+/K^+ pumps in the collecting duct of the kidney move three Na^+ ions into the blood and two K^+ ions out of the blood.
- 2 Cl^- ions enter the blood to maintain electrochemical balance.
- 3 H^+ ions enter cells lining the kidney tubules.

Which of the above statements explain(s) why excess aldosterone production can result in high blood pressure?

- A 1, 2 and 3
- B Only 1 and 2
- C Only 2 and 3
- D Only 1

Your answer

[1]

7. Birds and humans have similar pancreas tissues, with the same cell types contributing to exocrine and endocrine roles.

* Growth hormone (GH) is a peptide hormone that stimulates cell reproduction and regeneration in humans and other animals. It is produced during development to increase muscle mass and increase bone size and density.

GH can also be used in farming to enhance yields from different animals.

Design an experiment to investigate the following hypothesis:

"Varying the concentration of GH injected affects the yield of meat from farmed chickens"

You must explain how you would obtain valid data.

10. Fig. 21.1 shows a transverse section of a human adrenal gland.

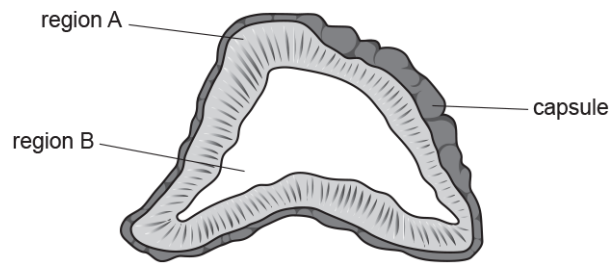


Fig. 21.1

i. The table below describes the functions of some hormones produced by different regions of the adrenal gland.

Complete the table using Fig. 21.1 and your own knowledge.

Hormone produced	Functions of hormone
adrenaline
.....	<ul style="list-style-type: none"> • increases heart rate • increases blood pressure • widens pupils
androgens	regulation of sexual characteristics and cell growth
.....	regulation of metabolism

[2]

ii. Using Fig. 21.1, identify the letter and name of the region of the adrenal gland that secretes adrenaline.

[1]

11(a). Birds and humans have similar pancreas tissues, with the same cell types contributing to exocrine and endocrine roles.

Table 21.1 gives some information about the hormones produced by the different regions of the adrenal gland.

Complete the table to include the correct region, hormone and role.

Region of adrenal gland	Hormone produced	Role of hormone in body
.....	aldosterone
medulla	Increases heart rate. Stimulates glycogenolysis.

Table 21.1

[2]

(b).

i. Fig. 21.1 shows a transverse section of pancreas tissue from a bird.

Select which letter identifies the following structures:

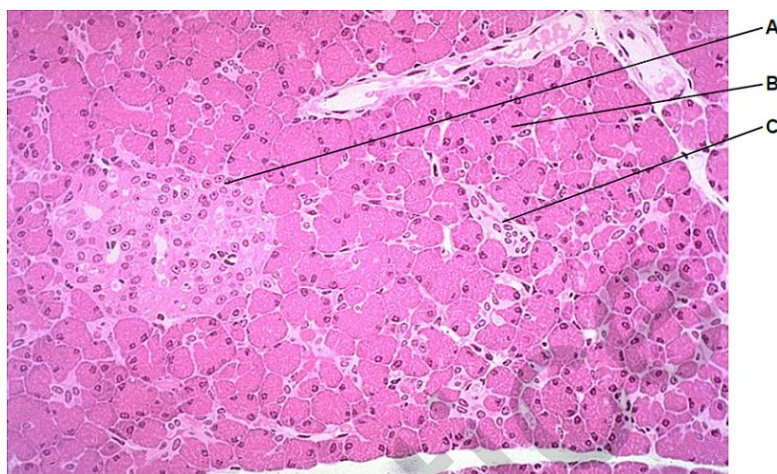


Fig 21.1

islet of Langerhans

..... [1]

acinus

..... [1]

- ii. Fig 21.2 shows a high-power image of cells from the pancreas.

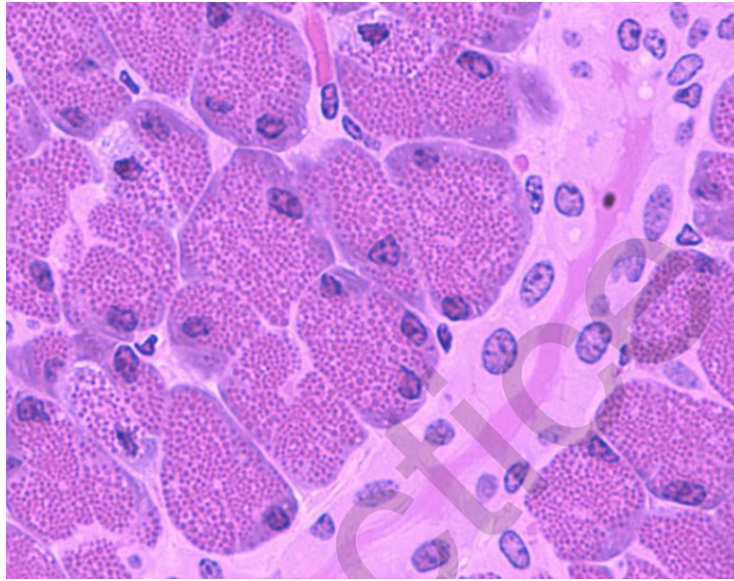
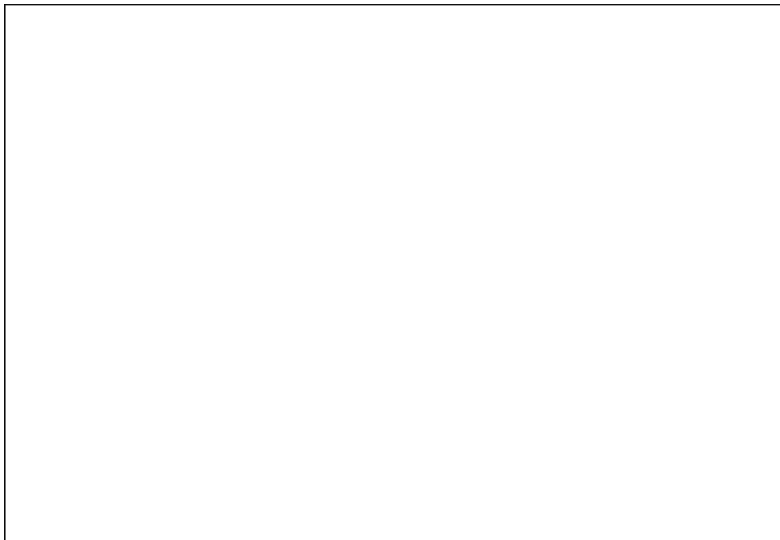


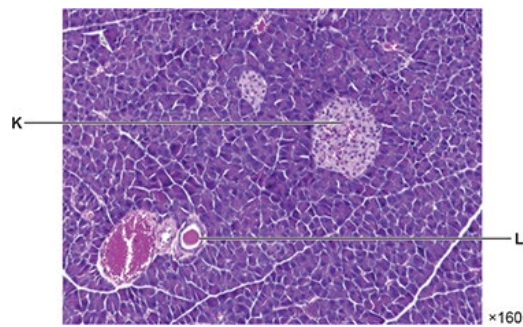
Fig 21.2

In the space provided below draw **five adjacent** cells, annotating them to show visible features.



12. The pancreas produces digestive enzymes and is also involved in the regulation of blood glucose concentration.

Fig. 17, in the insert, shows a light micrograph of a section of mouse pancreas.



Identify the structures labelled **K** and **L** in Fig. 17.

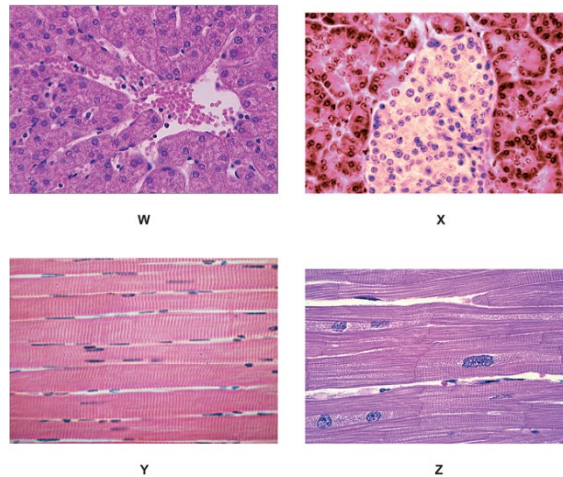
K

L

[2]

13. A student looked at slides of different tissues under a light microscope.

The four viewed images are labelled **W**, **X**, **Y** and **Z** in Fig. 23.1, below and on the insert H420/01, Biological processes (AS/A level), June 2018.



Identify tissues **W**, **X** and **Y**.

W

X

Y

[2]

14. The pancreas produces digestive enzymes and is also involved in the regulation of blood glucose concentration.

Scientists investigated the effect of the drug nifedipine on the secretion of insulin from pancreas cells in culture.

Pancreas cells were first incubated with glucose at a concentration of 3 mmol dm^{-3} . The concentration of glucose was then increased to 20 mmol dm^{-3} in the presence or absence of nifedipine.

The scientists then measured the amount of insulin secreted by the cells. They recorded their results as a percentage of the total insulin content of the cells. Each experiment was repeated seven times.

The results are shown in the table.

Condition	Mean insulin secreted (%)
Without nifedipine	7.8 ± 0.78
With nifedipine	0.8 ± 0.15

i. Name the cells that secrete insulin.

..... [1]

ii. Explain why it was necessary to increase the concentration of glucose surrounding the cells before they measured insulin secretion.

.....

 [2]

iii. Suggest and explain which statistical test the researchers would have used to analyse their data.

.....

 [2]

- iv. The statistical test gave a value of $p < 0.001$. Use the words 'chance' and 'probability' to draw a conclusion from the result of the statistical test.

[2]

- v. Nifedipine blocks Ca^{2+} -channels.

Explain how blocking calcium channels could inhibit insulin secretion.

[2]

15. Which of the statements about the control of blood glucose is correct?

- A** Pancreas cells increase their release of glucagon when blood glucose concentration rises above a set level.
- B** Glucagon stimulates the conversion of glycogen to glucose by liver cells.
- C** Insulin increases blood glucose concentration by stimulating glycogenesis and gluconeogenesis.
- D** The interaction of insulin and glucagon keeps the blood glucose concentration constant.

Your answer

[1]

16(a). Stem cell therapy is a potential future treatment for diabetes mellitus.

In the future, it might be possible to differentiate stem cells in a laboratory (*in vitro*) before they are implanted into the pancreas of a patient with diabetes.

- i. Name the type of differentiated cell that scientists would produce from stem cells in order to treat diabetes mellitus.

----- **[1]**

- ii. Which type of diabetes mellitus is most likely to be improved by stem cell therapy?

Explain your answer.

 ----- **[2]**

(b). Stem cells were extracted from the bone marrow of 131 patients with diabetes mellitus. Each patient received an implantation of their own stem cells.

Following the stem cell treatment:

- 53 patients showed no change
- 78 patients showed an improvement in their condition.

Suggest three additional pieces of information that would be needed to assess the effectiveness of the stem cell therapy.

1 -----

2 -----

3 -----

[3]

(c). The blood glucose concentration of a diabetes patient was measured on five separate occasions.

The five measured values (in mmol dm⁻³) were 8.7, 8.7, 9.0, 9.0 and 10.9.

i. Using the formula below, calculate the standard deviation of the patient's blood glucose concentration.

$$s = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}}$$

n = number of samples

x = each value in the data set

\bar{x} = mean

Answer [3]

ii. Explain why standard deviation is better than range for measuring the dispersion of these data.

[2]

iii. Scientists compared the blood glucose concentrations of two diabetes patients:

- a patient who had received stem cell therapy
- a patient who had received no stem cell therapy.

Describe **two** aspects of the experimental design that the scientists would need to consider in order to produce a valid comparison of the two patients.

[2]

17. Gestational diabetes is a medical condition that affects pregnant women. It results in high levels of glucose in the blood, even though the woman produces normal levels of insulin.

- i. Gestational diabetes is most similar to which **other** type of diabetes?

Explain your answer.

[2]

- ii. Suggest **two** ways a woman with gestational diabetes can manage her condition.

1

2

[2]

18. Diuretics are drugs that decrease the reabsorption of water into the blood from the kidney.

Diuretics can change the concentration of ions and other molecules in the blood.

Some diuretics are used to treat high blood pressure.

The table below lists three different diuretics, **X**, **Y** and **Z**, and some of their effects in the body.

	Without a diuretic	With a diuretic		
		X	Y	Z
Rate of urine production (ml min ⁻¹)	1	3	13	8
Blood chloride ion concentration (mmol dm ⁻³)	60	15	150	150
Blood potassium ion concentration (mmol dm ⁻³)	15	60	12	25
Blood glucose concentration (mmol dm ⁻³)	6	6	9	8

- i. Suggest which of the diuretics, **X**, **Y** or **Z**, would be the most effective at reducing a person's blood pressure. Explain your choice.

diuretic

explanation

[1]

- ii. Suggest which of the diuretics, **X**, **Y** or **Z**, would be the most appropriate for use by a person with type II diabetes. Explain your choice.

diuretic

explanation

[1]

20. During pregnancy, the hormone human chorionic gonadotrophin (hCG) is produced by the placenta. Fig. 16.1 shows how levels of hCG change throughout pregnancy.



Fig. 16.1

At birth, the production of another hormone, oxytocin, increases. Oxytocin causes rapid contractions of the uterus. These contractions cause more oxytocin to be released.

What term is used to describe this kind of interaction?

----- [1]